REMARKS

The Examiner's Office Action dated July 23, 2003 has been received and its contents reviewed. Claims 1-15 are pending in the instant application. By this Amendment, claim 5 has been amended to be made independent and new claim 15 has been added reciting the steps of correcting for the distortion, created during fabrication of the master mask, during fabrication of the child mask using the electron beam proximity apparatus as disclosed in the specification at page 5, lines 2-4. In view of these actions and the following remarks, reconsideration of this application is requested.

With regard to the Examiner's continued rejection of:

> Claims 1, 3, 8 and 10, under 35 U.S.C. §103(a), as obvious in view of the teachings of Randall ('138),
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> Claims 2, 4, 9 and 11, under 35 U.S.C. §103(a), as being obvious in view of the teachings of Randall ('138) combined with the teachings of Owen et al. ('265), and
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> Claims 5-7 and 12-14, under 35 U.S.C. §103(a), as being obvious in view of the teachings of Randall ('138) combined with the teachings of Dick et al. ('680),

each of these rejections is respectfully traversed at least for the reasons provided below.

Claim 1 of the present invention represents a technique for producing a child mask by an electron beam proximity exposure apparatus in which a mask having been produced by a mask writer, that is a conventional electron beam exposure apparatus, is used as a master mask. Specifically, the claimed process includes forming first a master mask using a "conventional electron beam exposure apparatus" to form the master mask which is then followed by employing an "electron beam proximity exposure apparatus" to form each of the child masks. See also Figure 2, elements 101 and 102.

In the claimed embodiment, the conventional electron beam exposure apparatus corresponds to a mask producing apparatus (denoted with a reference number 101 in the specification); while the electron beam proximity exposure apparatus corresponds

to a device of a wafer producing apparatus (denoted with a reference number 102 in the specification). The later apparatus is also clearly recited in the preamble of claim 1 and again in the body of claim when forming the child mask.

As noted in the previous Amendment of May 23, 2003, the two electron beam apparatus, i.e., the electron beam exposure apparatus (i.e., mask writer) and electron beam proximity exposure apparatus, are substantially different in structure and operation as pointed out by the "High Throughput Submicron Lithography with Electron Beam Proximity Printing" article by H. Bohlen et al, Solid State Technology (1984). The prior art conventionally employs only one method for producing a mask. That is, by the employing an electron beam exposure apparatus (mask writer) whenever required regardless of whether the mask to be produced is master mask or a child mask. In contrast, the present invention presents in claim 1 a method for producing number of child masks from one master mask by the use of the electron beam proximity exposure apparatus normally used for wafer device exposure.

The Applicants believe that the technique disclosed in the present invention for producing the child masks differs from that disclosed in the Randall reference. Specifically, the Examiner states in the Office Action that:

> "Randall teaches the use of other patterning technique[s] for manufacturing a child mask wherein said master mask is used in said manufacturing of said child mask (col. 5, lines 43-50)
>
> 5. Randall also teaches an electron beam proximity exposure method (col. 3, lines 47-68)."

However, the Randall patent at the portions referenced above by the Examiner states:

> Electron beam lithography may be used in a serial writing mode to achieve the high resolution contemplated by the preferred embodiment. **The use of electron beam lithography to expose this large quantity of squares may require a large amount of time. However, once a first mask has been made, the first mask may serve as a master for all future masks. These future masks may be exposed using ion beam lithography as described in connection with the present invention**. Of course, those skilled in the art may advantageously design other techniques for patterning the above-described high resolution pattern on surface 16.
>
> After the entire surface of layer 16 has been exposed, a developing step removes the exposed portions of layer 16. Next, an etching step removes

> portions of layer 14 which have become uncovered by the removal of portions of layer 16. Then, another etching step vertically etches through the entire thickness of epitaxial layer 12 in the areas defined by the removed portions of layer 14. The preferred embodiment contemplates the use of conventional ion beam or reactive ion etching techniques to perform this vertical etching.
>
> After etching through layer 12, an etch-back step is used to entirely etch away substrate 10 from epitaxial layer 12 underneath the portion of epitaxial layer 12 which serves as a mask after subsequent processing steps (discussed below). Consequently, a silicon frame (not shown) may remain surrouding this mask. As discussed above, the boron doping in epitaxial layer 12 provides an etch stop which conventional etching techniques exploit to differentiate substrate 10 from epitaxial layer 12. (Emphasis added)

As can be seen, the Randall reference teaches only using an electron beam lithography technique, i.e., the electron beam exposure apparatus (i.e., mask writer) as taught in the background of Randall, and the electron beam proximity exposure apparatus by the Bohlen et al. article above, to produce the master mask. Randall contains absolutely no discussion, in the above recited section or anywhere else in the patent, of using an electron beam proximity exposure apparatus to produce the child masks as presently claimed. To the contrary, Randall explicitly teaches using the master mask to produce all the future masks by an ion-beam method. If the Examiner is to maintain this position with regard to the teachings of Randall, it is requested that an explanation be provided as to how the techniques described in Randall would teach, suggest or motivate to one of ordinary skill in the prior art the use of an electron beam proximity apparatus (normally used for semiconductor wafer exposure) to form the child masks of Randall.

As described above, although there are a conventional "serial" mask producing electron beam exposure apparatus and a "currently-used" mask producing "parallel writing" electron beam exposure apparatus, as discussed in Randall (column 1, lines 28-40), neither of these are of the electron beam proximity exposure type. Further, the productivities of each apparatus are very different, i.e., the conventional serial apparatus has a much lower productivity than the currently-used parallel writing apparatus. However, the parallel writing apparatus suffers from dimensional control problems due to the proximity effect. This is the very reason Randall had to limit the

exposure method to producing the future (child) masks to an ion-beam type exposure tool.

More specifically, Randall, realizing the technical problems encountered when using either serial writing or parallel writing apparatus in producing exposure masks, avoids those difficulties by employing the ion-beam type apparatus to produce the child masks. Such a teaching clearly imparts to one of ordinary skill in the prior art that utilizing the electron beam proximity method to produce the child masks was not possible or desirable at the time of the invention of Randall. In contrast to Randall, the invention recited in claims 1 and 8 solves the above-described problems by preparing the future (child) masks by using as device known for producing patterned semiconductor wafers, i.e., an electron beam proximity exposure apparatus (and not the mask producing electron beam exposure apparatus). This feature of the invention is completely different and unobvious from the teachings of Randall.

Since Randall does not teach each feature of the presently claimed invention or suggest modifying the process/apparatus disclosed therein to achieve the method presently claimed, the rejection of claims 1, 3, 8 and 10, under § 103, is believed to have been set forth in error and should be withdrawn.

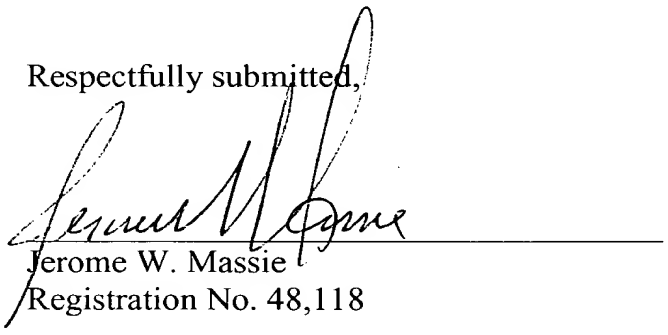
A review of the Owen et al. and Dick et al. references reveals that each disclosure does not contain a teaching with remedies the deficiencies of Randall noted above. While it is true that compensation methods for the reduction in resolution due to the proximity effect, per Owen et al. and the sub-deflection technology per Dick et al. are commonly known, the method of the present invention provides for improvements for the sub-deflection technology when the (master or child) mask producing procedure presently claimed is performed utilizing two separate, differently structured, electron beam apparatus as set forth.

Further, correction of sub-deflection in Dick et al. relates to the master mask producing apparatus. The present invention achieves precise correction, in the wafer device producing apparatus, on the child mask produced by the method of claims 1, 5 and 15 and not the master mask. For the above reasons, the combinations of Randall

and either Owen et al. or Dick et al. would not have made the present invention obvious to one of ordinary skill in the art. Therefore, the rejections of claims 2, 4-7, 9 and 11-14, under § 103, over the combination of teachings of Randall and Owen et al. or Dick et al. are also believed to have been set forth in error and should now be withdrawn.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



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